desmet ballestra
Science behind Technology

Food & Feed

Oils & Fats Processes

A new fractionation technology

Mobulizer Technologies

206 2010-10-11

Dry Fractionation today...

In the edible fats and oils industry of the 21st century, dry fractionation is well established as a proven, cost-effective and powerful modification technology.

Essentially, dry fractionation consists in a fractional crystallisation of oil, followed by a separation of the resulting fat crystals from the remaining liquid oil. The adjective "dry" refers to the absence of any solvents, catalysts or chemical additives during the process. For that reason, dry fractionation stands out as the true zero-effluent modfication technology, unlike solvent fractionation, chemical interesterification, (partial) hydrogenation, etc...

It follows that, being a purely physical and therefore reversible process, dry fractionation can be applied to many different types of fats and oils (Table 1). In turn, this has resulted in a continuously expanding spectrum of edible oils and fat products meeting specific physical quality demands (Table 2). This trend has called for improved performance of the existing fractionation technology and more specifically the crystalliser, which is in fact the heart of any industrial fractionation plant.

To answer this demand, Desmet Ballestra is proud to present the latest addition to their line of the well-known Flexifrac® fractionation crystalliser designs : the MoBulizer, a state-of-the-art desing returning real value for money to our customers, whether they emphasize commodity products or tailor-made speciality fats.
This brochure will guide you through the basic principles of fractionation technology, meanwhile emphasizing in which fields the MoBulizer has brought real added value to Desmet Ballestra's Flexifrac Fractionation.

Table 1

Frequently fractionated fats and oils	
Vegetable origin	**Animal origin**
Palm Oil	Anhydrous Milk Fat
Palm Kernel Oil	Lard Oil
Partially Hydrogenated Soybean Oil	Tallow
Coconut Oil	Fish Oil
Shea Butter	

Table 2

Applications
Margarines, shortenings
Salad oils, dressings
Frying & Cooking oils
Confectionery fats • Cocoa Butter Equivalents • Cocoa Butter Alternatives • Cocoa Butter Substitutes • Filling Fats • Coating Fats
Oleochemical industry
Cosmetics

... with performant technology

The concept of dry fractionation Technology

Crystallisation

Dry fractionation is typically carried out in a batch mode. Teh root of the process is a fractional (= partial) crystallisation process taking place in the crystalliser :

The feedstock oil is filled into the crystallisers at high temperature to ensure melting of all residual crystalline structures. Upon cooling the crystalliser, the oil will be brought into a supercooled state. The nucleation of crystals will then take place, followed by a slow crystal growth and agglomeration. During this sequence, it is crucial to maintain proper heat and mass transfer, for the exothermic crystallisation reaction will release about 200 kJ for every kg of oil crystallised (for comparison, the heat release upon cooling of the liquid is only about 2 kJ/kg°C). As the content of solid fat in the oil will increase during the reaction, also the viscosity will alter and in turn affect the heat exchange rates too.

A successful fractional crystallisation therefore relies on the correct control of various process parameters and the knowledge of the crystallisation behaviour of the oil :

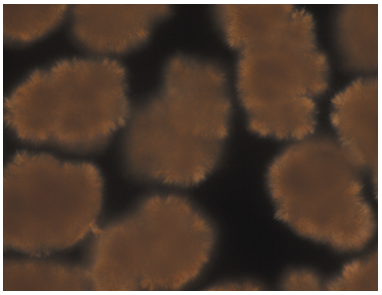
Controlled temperature
The supercooling imposed on the oil will be the driving force for the crystallisation reaction until the end of the process. The temperature of the oil can be perfectly regulated by an energy-saving cooling water circuit. A well-chosen temperature program thus allow to selectively crystallise thos components in the oil you need, and nothing else, leading to pure and homogeneous crystals.

Proper agitation
Agitation is generally benificial as if favours mass and heat transfer in the oil and keeps the formed crystals in suspension in the melt. However, too forceful agitation will invoke high shear on the crystals, which could lead to fragmentation and a heterogeneous crystal size distribution. Therefore, agitation systems need to be designed in a geometry that ensures optimal flow and mixing but minimal shear.

Effective heat exchange
Compared to most other oil refining and modification technologies, dry fractionation is a slow process : oil is a poor heat conductor and so crystallisation of the constituting triglycerides needs time to assemble in a correct composition (intersolubility) and molecular arrangement (polymorphism).

The optimal time for one crystallisation cycle is thus quite dependant on the the composition of the oil (eg. some minor components could delay crystal growth), and it shows that the key is to know how fast you can go in which oil.
The crystalliser design should thus offer accurate and homogeneous temperature control, efficient agitation and fast heat exchange.

The line of Desmet Ballestra's Flexifrac has been designed adhering to these guidelines, in order to produce a low-viscous suspension of high quality crystals in the shortest of possible times, on a wide range of products.



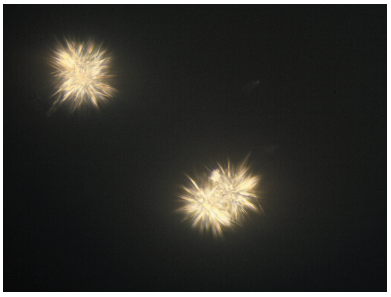
Dry Fractionation today...

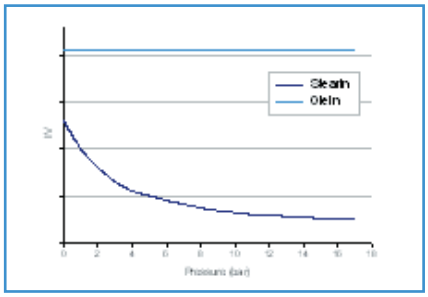
Separation

The outcome of a dry fractionation process is not only determined by the crystallisation process the subsequent phase, separation, is very relevant too.

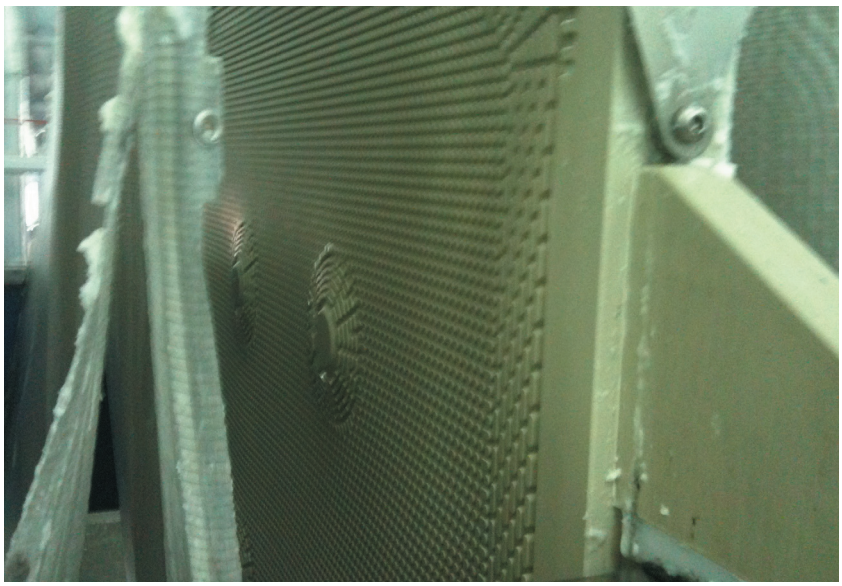
In this stage, the crystals are effectively separated from the liquid. Nowadays this is most commonly done by using membrane filter presses, while the number of plates running with a vacuum filter is in decline. A membrane press filter operation occurs in two steps : during filtration the crystal suspension is sent over the filter cloth retaining the crystals while the liquid olein can flow through the storage («filling»). When the filter chambers are sufficiently filled, the membranes are inflated with a pressure medium such as water or the olein itself.

This invokes a further compaction of the crystal cakes («squeezing») and additional olein can be recuperated. The effect of the squeezing pressure is illustrated below. The standard max. pressure is 15 barg as a good compromise between olein yield and stearin quality, but in some cases applying up to 30 barg can make all the difference to obtain a premium quality stearin (eg. for cocoa butter alternatives). Features such as a two-way filter





filling, cake discharge devices, multiple plate transfer systems, safety light curtain, electrostatic energy prevention ... have now become so accustomed in fractionation plants that the filtration process can be operated with minimal manual intervention.



... with Mobulizer Technology

MoBulizer stands for «Moving Bundle» crystalliser and hence reflects the integration of a cooling and agitation in one system.

Most conventional crystallisers are equipped with rotational agitators, which will cause shear to vary proportional to the axis of rotation. When the mass transfer decreases because of rising viscosity, the transfer from and to the heat exchange surface will easily become limited.

MoBulisers however have an integrated agitation/cooling system, which makes it possible to move slowly through the oil, maintaining a low and uniform speed through the total oil volume.

Especially in oils fractionated in viscous conditions, this is translated into excellent heat and mass transfer, and thus a better controlled process.

Additionally, the MoBuliser has been designed in such a way that it requires minimal construction and material costs, which offers a considerable saving on both investment and energy consumption.

The Advantages of traditional fractionation technology

- Lower investment costs
- Less steel and less water to heat/cool
- Improved uniform mixing
- Lower power consumption
- Less crystal fragmentation, adding to separation efficiency
- Consistant capacity, constant quality
- Very selective crystallisation possible, in short cycle times
- Suitable for a wider range of fats
- Flexible to adapt to continuous fractionation
- Flexible design : different sizes available with identical geometric agitation system.
- Optimisation of layout : groud floor vs; intermediate floor installation, both are possible
- Smooth transition for crystalliser section to filter section
- Optimised water circuit
- Custom material choice : Full SS, CS, CS + epoxy coating

Features & Options

Safety during filtration

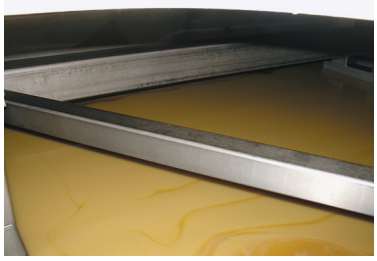
A sliding chain, equipped with hooks, moves the membrane blocks one after the other. A safety strip is installed alongside the press to stop mechanical operation at any moment if required.

Filter Elements Shaking Device

For special applications, a filter elements shaking device can be provided.

Prevention of electrostatic energy

Also special antistatic filtercloths and filter plates have been developed to prevent built up of electrostatic energy during filtration.



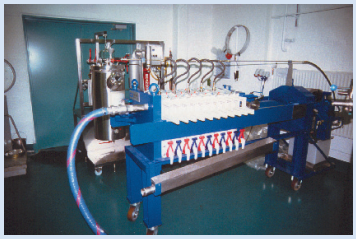
Pilot Plants

Laboratory scale pilot fractionation

This pilot is concieved for our customers, allowing them to make laboratory trials on a 10 kg batch. Once the trials have led to a new marketable fractionated product, the production parameters can be extrapolated on an industrial scale

Larger scale pilot fractionation

This pilot is concieved to make trials on a scale of 200 kg/ batch. This pilot is quite usefull for the market referencing of a new product



oils & fats

desmet ballestra

Worldwide Leadership

Technical Innovation

Research and Development

Project Management

Quality Workmanship

Customer Service

Export Expertise

Turnkey Contracting

PREPARATION	Cleaning Cracking Dehulling Cooking Flaking Expanding	Cashew nut Castor seed Cocoa Copra Corn Cotton seed Fish oil Grape seed Groundnut Jojoba Lard Linseed Mustardseed Olive Palm Palm kernel Rapeseed(Canola) Ricebran Safflower Salseed Sesame seed Sheanut Soyabean Sunflower Tallow Tung
PRESSING	Full Pressing Prepressing	
EXTRACTION	Extracting Desolventising Toasting Distillation Solvent Recovery	
REFINING	Degumming Neutralising Bleaching Winterising Deodorising	
FAT MODIFICATION	Fractionation Hydrogenation Interesterification	
OLEOCHEMICALS	Fat splitting Glycerine refining Sweetwater evaporation Fatty alcohols Fatty acids fractionation Oleic acid separation Fatty acids hydrogenation Biofuel	

Food & Feed

Oils & Fats

Animal Feed

Chemicals for Life

Oleochemicals

Detergents, Surfactants & Chemicals

Soap

Biofuels

Biodiesel

Bioethanol

Biomass